

---

# Life Expectancy by Employment Status, Income, and Education in the National Longitudinal Mortality Study

EUGENE ROGOT, MA  
PAUL D. SORLIE, PhD  
NORMAN J. JOHNSON, PhD

Mr. Rogot and Dr. Sorlie are Statisticians with the Epidemiology and Biometry Program, National Heart, Lung, and Blood Institute, National Institutes of Health, Bethesda, MD. Dr. Johnson is a Statistician in the Statistical Methods Division with the Bureau of the Census, Washington, DC.

Tearsheet requests to Eugene Rogot, National Heart, Lung, and Blood Institute, Federal Building, Room 2C08, 7550 Wisconsin Avenue, Bethesda, MD 20892, telephone 301-496-8887.

## Synopsis .....

*Based on data from the National Longitudinal Mortality Study for 1979-85, life expectancies are estimated for white men and white women by education, by family income, and by employment status. Life expectancy varies directly with amount of schooling and with family income.*

*Differences in life expectancy at age 25 between the highest and the lowest levels of education completed were about 6 years for white men and about 5 years for white women. For family income, differences between the highest and the lowest income groups were about 10 years for white men and 4.3 years for white women. The largest differences in life expectancy were between employment categories. At age 25, white men in the labor force lived on average about 12 more years than those not in the labor force, and white women lived on average about 9 more years. For those who were unable to work compared with those in the labor force, the difference for white men was about 20 years; for white women, 29 years.*

*Results in this study showed much the same differentials in life expectancy for education as the earlier Kitagawa-Hauser study.*

---

**E**STIMATES OF LIFE expectancy according to education have been reported by Kitagawa and Hauser for white men and white women in the United States (1). These were based on abridged life tables constructed from their now classic cross-sectional study of mortality in the United States in 1960. Our report studies life expectancy in 1979-85 by employment status and income, as well as by education, for the noninstitutionalized population of the United States. Data are from the National Longitudinal Mortality Study (NLMS) (2).

Our main objectives are to provide more current life expectancies for selected groups according to family income, education, and employment status, and to assess differences between groups.

## Methods

The study population consists of 822,347 white persons who were in recent census samples, as part of the NLMS, a prospective study of mortality in the United States (2). The samples were drawn from the Current Population Surveys (CPS) of March 1979, 1981-85 and April, August, and December of 1980. These samples were designated

as cohorts for mortality followup, that is, the persons were known to be alive on the survey date, and therefore eligible for followup from that date on. In our study, the deaths of persons were ascertained by means of the National Death Index (NDI) (3) to the end of 1985.

The CPS is a household and telephone interview survey conducted by the Bureau of the Census and consists of a probability cluster sample of households from the civilian noninstitutionalized population of the United States (4). This survey has a response rate of approximately 96 percent. The primary purpose of the CPS is to provide estimates of monthly labor force participation. The CPS also provides data on various socioeconomic and demographic factors and includes data needed for record linkage with the NDI.

The matching procedures and related methods used in the NLMS have been described in earlier reports (2,5-7). For our study, the Census samples were matched to the NDI for the years 1979-85. A total of 14,673 deaths of white males and 11,352 deaths of white females occurred among these cohorts. By use of a person-year approach, using attained age, 1-year probabilities of death for single

Table 1. Standard errors of estimated life expectancy ( $e_x$ ) values, in years, by age category for white males (WM) and white females (WF)

Variables	$e_{25}$		$e_{45}$		$e_{65}$	
	WM	WF	WM	WF	WM	WF
<b>Education (years):</b>						
0-4	.68	.73	.51	.58	.34	.38
5-7	.45	.41	.36	.38	.23	.26
8	.44	.39	.27	.31	.17	.19
9-11	.29	.28	.24	.25	.20	.21
12	.19	.18	.18	.18	.17	.17
13-15	.31	.30	.30	.30	.29	.27
16	.39	.41	.38	.40	.37	.37
17 or more	.47	.61	.46	.60	.47	.58
<b>Family income (1980 \$):</b>						
Less than 5,000	.48	.39	.41	.34	.22	.17
5,000-9999	.32	.26	.29	.24	.15	.16
10,000-14,999	.28	.26	.26	.25	.19	.21
15,000-19,999	.30	.34	.28	.33	.26	.31
20,000-24,999	.33	.38	.32	.38	.32	.38
25,000-49,999	.26	.31	.26	.31	.27	.31
50,000 or more	.52	.66	.51	.65	.53	.66
<b>Employment status:</b>						
In labor force	.27	.57	.27	.57	.31	.61
Not in labor force	.43	.14	.31	.13	.09	.09
Housework	.16	.16	.14	.14	.11	.11
Unable	.91	1.64	.43	.84	.24	.43
Other	.59	.53	.40	.40	.10	.19
NLMS, 1979-85	.10	.10	.09	.10	.08	.08
U.S., 1979-81	.01	.01	.01	.01	.01	.01

NOTE: NLMS = National Longitudinal Mortality Study.

years of age were estimated for selected socioeconomic groups, and life tables were constructed. Estimated life expectancies ( $e_x$ ) are then compared between groups.

Life tables were constructed for ages 25-95. No smoothing of probabilities was undertaken. The closing life expectancy value in each table, that for age 95, was taken as 2.91 years for white men and 3.39 years for white women, which are the values given in the U.S. Decennial Life Tables for 1979-81 for white males and white females (8). Standard errors of  $e_x$  were also calculated, after Chiang (9), and are given in table 1. The factors studied included employment status that is based on a detailed employment history obtained by the CPS interviewer. For analyses in our paper, categories of "in the labor force" and "not in the labor force" were used. Those in the labor force include both employed and unemployed persons. Those not in the labor force include persons engaged in their own housework, going to school, unable to work, and "other," a category that includes retired persons or persons not working for any other reason. For education, the highest level completed was determined. For family income, the combined in-

come of all members of the family was determined and adjusted to 1980 levels by use of the Consumer Price Index (10).

## Results

We compared first life expectancy in our study group with that for the United States for white men and white women. Overall estimates of  $e_x$  at ages 25, 45, and 65 were as follows:

Ages (years)	NLMS, 1979-85	U.S., 1979-81
<b>White men</b>		
25	50.0	47.9
45	31.2	29.5
65	15.4	14.3
<b>White women</b>		
25	57.0	54.6
45	37.8	35.5
65	20.6	18.5

Figures for the United States were obtained from the published life tables (8).

As shown, life expectancies in the NLMS were consistently greater than in the United States life tables by about 1 to 2 years. The principal reason for this is the lower mortality rates expected for a noninstitutionalized population compared with the general population. Another reason may be the lack of perfect ascertainment of death in using the National Death Index. This is thought to be a minor problem here since social security numbers were available for matching to the NDI for the vast majority of persons followed (86 percent of those ages 25 and older).

Substantial differences in life expectancy between white men and white women are noted for the NLMS. These differences were, however, similar to, but slightly greater than, those found for the United States. Thus, at age 25, the difference in the NLMS was 7 years in favor of white women over white men, compared with a 6.7 year difference in the United States. At age 45, the difference was 6.6 in the NLMS compared with 6.0 in the United States; at age 65, the difference was 5.2 in the NLMS compared with 4.2 in the United States.

The main results of our study are presented in tables 2-4, where estimates of life expectancy at ages 25, 45, and 65 are given for selected socioeconomic groups for white men and white women.

Table 2 presents data according to education level attained. The relationship between schooling and average length of life is in general a direct one—as schooling increases, life expectancy increases. For white men, the difference in life expectancy between the highest grade completed

and the lowest is about 6 years at age 25, 5 years at age 45, and 3.3 years at age 65. For white women, corresponding differences were slightly smaller, 5 years at age 25, 4.4 years at age 45, and 2.4 years at age 65.

Table 3 presents data according to amount of family income. The relationship between income and average length of life is also a direct one—as income increases, life expectancy increases. For white men, the difference in life expectancy between the highest income and the lowest is about 10 years at age 25, 8 years at age 45, and 4 years at age 65. For white women, corresponding differences were much smaller, about 4 years at ages 25 and 45 and about 1 year at age 65.

Table 4 presents data by employment status. Large differences in life expectancy between persons in the labor force and those not in the labor force are apparent. For white men at age 25, those in the labor force could expect to live 53.4 more years on the average compared with only 41.5 more years for those not in the labor force—a difference of nearly 12 years. For white men, the difference in life expectancy at age 45 was about 9 years and at age 65 about 4 years. Comparable differences in life expectancy for white women were about 5 years at ages 25 and 45 and 3.5 years at age 65. The largest differences in life expectancy were seen for persons who were unable to work compared with persons in the labor force. This difference was 20 years for white men age 25 and 29 years for white women age 25. At age 45, the difference was close to 16 years for white men and 21 years for white women. At age 65, these differences were still substantial—nearly 11 years for white men and 12 years for white women. Persons in the category “other,” that includes retired persons, fared much better than the “unable” group but had much lower life expectancies than persons in the labor force. Differences for white men were 10.6 years at age 25, 7.8 years at age 45, and 3.4 at age 65; for white women, differences were 8.6 at age 25, 7.4 at age 45, and 4.7 at age 65. White women in the category “housework” fared much better than the “other” group, but still had lower life expectancies than white women in the labor force. Differences here were 3.7 years at age 25, 3.5 at age 45 and 2.6 at age 65.

## Discussion

In the interpretation of these data, it is important to keep in mind that each life table is constructed for persons who are at a given level of

Table 2. Life expectancy in years for white males (WM) and white females (WF) at ages 25, 45, and 65 by education, NLMS 1979–85 followup

Highest grade completed	e <sub>25</sub>		e <sub>45</sub>		e <sub>65</sub>	
	WM	WF	WM	WF	WM	WF
0–4	48.2	54.4	30.1	35.6	14.8	19.7
5–7	47.9	56.1	29.2	36.5	14.7	19.9
8	47.5	55.7	29.6	36.7	14.5	20.2
9–11	48.0	56.6	30.0	37.5	14.7	20.6
12	50.2	57.2	31.5	37.9	15.7	20.5
13–15	50.9	57.8	32.2	38.7	16.2	21.4
16	53.3	58.3	34.1	39.0	17.3	21.3
17+	54.5	59.4	35.1	40.0	18.1	22.1

Table 3. Life expectancy in years for white males (WM) and white females (WF) at ages 25, 45, and 65 by family income, NLMS, 1979–85 followup

Family income (1980 \$)	e <sub>25</sub>		e <sub>45</sub>		e <sub>65</sub>	
	WM	WF	WM	WF	WM	WF
Less than 5,000	43.6	53.7	26.2	35.0	13.3	20.0
5,000–9,999	46.1	56.0	27.9	36.9	14.4	20.3
10,000–14,999	48.7	56.6	30.1	37.4	15.6	20.4
15,000–19,999	50.8	56.9	32.2	37.6	16.2	20.4
20,000–24,999	51.5	57.9	32.5	38.7	16.4	21.2
25,000–49,999	52.4	57.8	33.2	38.5	16.5	20.6
50,000 or more	53.6	58.0	34.4	39.0	17.2	21.1

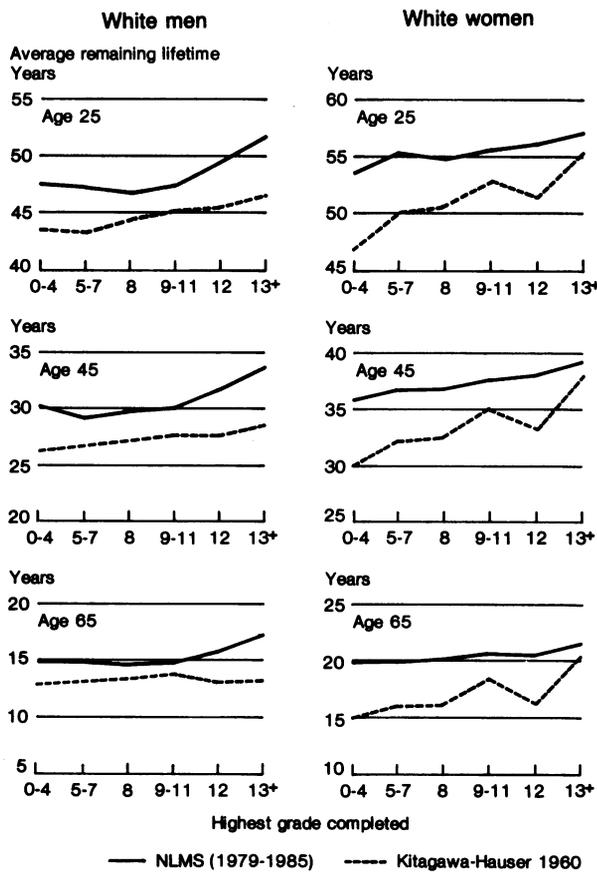
Table 4. Life expectancy in years for white males (WM) and white females (WF) at ages 25, 45, and 65 by employment status, NLMS 1979–85 followup

Employment status	e <sub>25</sub>		e <sub>45</sub>		e <sub>65</sub>	
	WM	WF	WM	WF	WM	WF
In labor force	53.4	60.9	34.6	41.6	18.4	23.8
Not in labor force	41.5	55.7	25.3	36.7	14.5	20.3
Housework	...	57.2	...	38.1	...	21.2
Unable	33.4	31.5	18.9	20.6	7.7	11.8
Other	42.8	52.3	26.8	34.2	15.0	19.1

a characteristic at the start of followup and are assumed to remain at that level. Of the three factors studied, education is clearly the least likely to change after age 25 while family income and employment status can change.

As seen in tables 2–4, observed differences in life expectancy according to education, income, or employment status were substantial. Differences tended to be larger for white men than for white women, especially between income levels. The largest differences were between employment status categories. At age 25, the difference between those in the labor force and those unable to work was 20 years for white men and 29 years for white women.

Comparing life expectancies for white men and white women at ages 25, 45, and 65, by education, in the National Longitudinal Mortality Survey (NLMS) 1979-85 and the Kitagawa-Hauser study, 1960



In this one instance, for the unable to work, white women had a lower life expectancy than white men (31.5 years compared to 33.4); however, this difference in life expectancy of about 2 years was not statistically significant because of relatively large standard errors (see table 1). The huge differences in life expectancy seen here could perhaps have been anticipated, since the "unable" group by definition includes only persons with long-term physical or mental illness or disability who are unable to do any kind of work. A comparison of this group with those in the labor force is, in effect, contrasting the survival experience of a very "sick" population with a "healthy" population. The "other" category for employment status, as well as the "housework" category for women, probably also include some sick persons (11). Employment status appears to be an excellent screen for separating the healthy from the sick people.

Family income and life expectancy were shown

to be strongly related, particularly for white men. At age 25, white men at the low end of the scale, those with family incomes of less than \$5,000, could expect to live on the average about 44 more years compared to 54 more years for those with family incomes of \$50,000 or more.

Education and life expectancy were also shown to be strongly related although not quite as strongly as the association between life expectancy and income or employment status.

Values of  $e_x$  for education in our study may be compared with those obtained by Kitagawa and Hauser (K-H) for the United States in 1960. This comparison is given in the chart. For the same reasons given heretofore in the comparison with the United States for 1979-81, NLMS values would be expected to be somewhat greater than K-H values. Also, life expectancies in the NLMS are higher than in the K-H Study because of lower mortality rates in the 1980 period than in 1960. More important than the absolute values, however, is the direct relationship between educational level and life expectancy. The gradient appears to be very strong in both studies. The NLMS and K-H curves in the chart are generally similar for each of the age-race-sex groups shown. For white men, however, a slightly stronger gradient is noted for the NLMS in the 1980 period; for white women, a slightly stronger gradient is noted for the K-H study in 1960.

Although death rates were lower in 1980 than in 1960, resulting in greater life expectancy in 1980, the differential in life expectancy by education is as large in 1980 as in the earlier period.

References.....

1. Kitagawa, E. M., and Hauser P. M.: Differential mortality in the United States: a study in socioeconomic epidemiology. Harvard University Press, Cambridge, MA, 1973.
2. Rogot, E., et al.: A mortality study of one million persons by demographic, social and economic factors: 1979-1981 follow-up. NIH Publication No. 88-2896. National Institutes of Health, Bethesda, MD, 1988.
3. National Death Index user's manual. DHHS Publication No. (PHS) 90-1148. National Center for Health Statistics, Hyattsville, MD, 1990.
4. U. S. Bureau of the Census: The current population survey: design and methodology. Technical Paper 40. U.S. Government Printing Office, Washington, DC, 1978.
5. Rogot, E., Sorlie, P., and Johnson, N. J.: Probabilistic methods in matching census samples to the National Death Index. J Chronic Dis 39: 719-734 (1986).
6. Rogot, E., et al.: On the feasibility of linking census samples to the National Death Index for epidemiologic studies: a progress report. Am J Public Health 73: 1265-1269 (1983).

7. Rogot, E., Schwartz, S. H., O'Connor, K. V., and Olsen, C. L.: The use of probabilistic methods in matching census samples to the National Death Index. 1983 Proceedings of the Section on Survey Research Methods, American Statistical Association, Washington, DC, pp. 319-324.
8. United States decennial life tables for 1979-1981. DHHS Publication No. (PHS) 85-1150-1 [1] No. 1, National Center for Health Statistics, Hyattsville, MD, 1985.
9. Chiang, C. L.: Introduction to stochastic processes in biostatistics. John Wiley & Sons, New York, 1968, p. 211.
10. U. S. Bureau of the Census: Statistical abstract of the United States: 1989, Ed. 109. U.S. Government Printing Office, Washington, DC, 1989, pp. 461-463.
11. Sorlie, P. D., and Rogot, E.: Mortality by employment status in the National Longitudinal Mortality Study. Am J Epidemiol 132: 983-992 (1990).

## HIV Infection Treatment Costs Under Medicaid in Michigan

DAVID J. SOLOMON, PhD  
ANDREW J. HOGAN, PhD

Dr. Solomon is Assistant Professor of Internal Medicine, University of Texas Medical Branch at Galveston. Dr. Hogan is Associate Professor of Medical Education Research and Development, College of Human Medicine, Michigan State University.

The research was supported by the Public Health Service, Agency for Health Care Policy and Research, under grant HS 06185-01.

Scott D. Merwin, MS, Medical Service Administration, Michigan Department of Social Services, obtained and processed the Medicaid payment records. James Kent, MS, AIDS Epidemiologist, Michigan Department of Public Health, obtained data from death records and the Michigan AIDS Surveillance Registry. Reynard R. Bouknight, MD, PhD, Department of Internal Medicine, College of Human Medicine, Michigan State University, assisted in interpreting and coding Medicaid payment records. Carolyn T. Solomon, RN, and Margaret V. Clark, RN, MS, interpreted and coded Medicaid payment records used in the analysis.

Tearsheet requests to David J. Solomon, PhD; University of Texas Medical Branch, 4.174 Old John Sealy Hospital E-66, Galveston, TX 77555-0566; tel. (409) 772-9843; fax (409) 772-6507.

### Synopsis .....

*The Michigan Medicaid Program payment records generated in the period 1985-89 by 783 persons were analyzed for services related to human immunodeficiency virus (HIV) infection. Other data from death records and the Michigan*

*AIDS Surveillance Registry were available for a subset of those persons. The average monthly payment in 1989 dollars for HIV-related services was \$1,302.57. Services determined to be unrelated to HIV infection accounted for 12.5 percent of the total amount for health care received and another 2.5 percent was questionable. The average monthly expenditure for men was roughly twice that for women. The discrepancy did not exist among persons identified in the AIDS Surveillance Registry. Sex differences ceased to exist when Medicaid eligibility (disability versus Aid to Families with Dependent Children) was controlled for by analysis of variance.*

*There were no significant differences between payments to those infected through male-to-male sexual contact and those infected through intravenous drug use. Payments for HIV treatments rose with age to about 40 years, and declined slightly among older adults. The sharpest rise was for those ages 19-25 years and 26-35 years. Large sex differences existed among those who received zidovudine (AZT), 61.4 percent of the men and 19.1 percent of the women. Controlling for Medicaid eligibility moderated those differences, but they remained statistically significant. Differences in zidovudine usage were not found between men and women in the subset identified in the AIDS Surveillance Registry nor among persons infected through male-to-male sexual contact and intravenous drug use.*

**A**S THE NUMBER OF PEOPLE NEEDING TREATMENT for human immunodeficiency virus (HIV) infection grows, the total cost of their health services is increasing sharply. Treating all those with HIV infection nationwide in 1991 has been estimated to have cost \$5.8 billion (in 1990 dollars) (1).

The financial and social impact of HIV infection

will increase significantly in the near future with an estimated 1 to 1.5 million persons now infected (2) and with the long latency period of the disease. Whereas HIV infection in the past predominantly affected young gay men, it is now occurring in a much more diverse population. Death records indicate that HIV infection is the 10th leading cause of